

APPLICATION FOR
UNITED STATES LETTERS PATENT
SPECIFICATION

TO WHOM IT MAY CONCERN:

Be it known that we, **JERRY E. BANDSTRA**, a citizen of the United States, residing at 1416 Broadway Street, in the City of Pella, County of Marion and State of Iowa; and **BRADLEY D. NELSON**, a citizen of the United States, residing at 207 W. Pleasant Street, City of Monroe, County of Jasper, and State of Iowa 50219, have invented a new and useful **WIDE PICKUP HEADER FOR A ROUND BALER**, of which the following is a specification.

WIDE PICKUP HEADER FOR A ROUND BALER

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INVENTORS

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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to farm machinery. More particularly the present invention relates to a forage harvesting machine that includes a pickup header that is wider than the bale forming unit, providing the capability to pickup forage in a windrow that lies outside the side-boundaries of the bale forming unit.

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Background Art

Forage may be harvested with a large round (cylindrical) baler, for instance. Such harvesting equipment, such as large round balers, include a pickup header for lifting the forage off the ground, from the windrow, and directing it into the harvesting equipment. Not infrequently, due to equipment wheels or wind, a windrow may become wider than the processing portion of the harvester, such as the bale-forming chamber of a large round baler. As well, when turning, it may become difficult or impossible to align the pickup header with the existing windrow. In either of these cases, the material outside the side of the processing portion (such as the bale-forming unit of a large round baler) needs to be moved in a direction perpendicular to the windrow, as well as being picked up, in order to be positioned to correctly engage the processing elements.

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In a large round baler, the material that is picked-up by the header is transported to the bale forming chamber for processing, for being compacted into a round bale.

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Many models of round balers are manufactured, typically either fixed chamber balers or variable chamber balers. The fixed chamber balers include a bale forming chamber of a fixed bale diameter, where the material is not significantly compacted until the bale reaches the bale diameter. The variable chamber balers include a bale forming chamber of variable diameter, and the material is compressed as it is formed. Both types typically are mounted on a 2-wheel chassis, to be pulled by a tractor.

The location of the pickup header relative to the bale forming chamber is important for both types of round balers, as minimizing the distance in which material travels between the pickup and the bale forming chamber reduces potential negative affects. These negative affects include the potential for undesirable movement, like material being affected by strong cross winds, and damage caused to the crop, an example being leaf loss for alfalfa. For variable chamber balers this relationship is more critical as the pickup tines or teeth act on the crop material when beginning to form a small bale, as it begins to be compacted and the bale begins to be formed. The location of the pickup will thus affect the capability of the baler to properly start forming a bale.

The location of the pickup header relative to the baler wheels is also important because the wheel/tire diameter is fairly constant. If the header is close to the baler wheels then the baler wheels will assist to control the ground clearance of the pickup tines. In balers where the header is located a significant distance from the baler wheels, the pickup header typically has separate gauge wheels to control the ground clearance.

Many models of balers are available that include a pickup header that is wider than the bale forming chamber. In many of these currently available machines there is a feeding device between the pickup and the inlet to the baler, an example of which can be seen in U.S. Patent 6,314,708. This feeder has been found to be necessary to achieve desired feeding capacity, and to provide the necessary feeding force to achieve desirable performance. However, this extra component causes the pickup to be moved relative to the baler wheels, causing more difficult control of the ground clearance of the pickup header. It also requires an additional drive system with the associated cost and complexity.

A wide pickup header for a large round baler is disclosed in European Patent #0064112 in which short augers, one on each side of the pickup header, direct the forage into the center so it can enter the bale-forming chamber of the baler.

5 In various locations on the pickup header, teeth or tines of varying rigidity are advantageous, enhancing the pickup and delivery of the forage material to the processing portions of the harvesting equipment. A round baler having stiff teeth is disclosed in U.S. Patent 5,394,682. Indications in this patent are that the use of stiffer than usual teeth at the outside ends of the pickup header improves pickup and delivery of the forage to the round baler.

10 There is, therefore, a need for a method and apparatus for providing for a wide pickup header for forage harvesting that does not require that the header be relocated away from the wheels of the harvesting equipment. There is a further need for a variety of teeth to be used across the width of the header.

15 Summary of the Invention

A broad objective of the present invention is for a reliable method and apparatus for providing a pickup header on harvesting equipment that is wider than the harvesting equipment and does not require a secondary feed mechanism. Along with this objective is the purpose to provide a lateral feed system that provides the feeding force to direct
20 the crop material perpendicular to the windrow toward the center of the pickup header. It is a further purpose of the invention to enhance the pickup and delivery of forage with a pickup header by varying the characteristics of the teeth or tines on the pickup header.

According to the present invention there is provided a pickup header assembly for a crop processing machine that is capable of picking-up crop material from a windrow of
25 a width less than or equal to that of the pickup header and delivering the material to processing elements that are narrower than the width of the pickup.

A lateral feed system is disclosed that comprises a pair of augers at each end of the pickup header. In each pair of augers, one auger is positioned vertically over the other. In each pair, the rotational speeds are different. The pairs of augers provide the force

required to move the forage toward the center of the pickup header and, ultimately, into the processing portion of the harvesting equipment, such as the bale-forming chamber of a large round baler. The lateral feed system does not require that the pickup header be moved relative to the bale forming chamber, as compared to its position with a
5 pickup header that is not wider than the bale forming chamber. Special consideration is required to assure that the lateral feed system does not clog with forage during operation.

Individual characteristics for the tines or teeth within the pickup header are chosen based on the special needs for the location in the pickup header at which they will be
10 installed. Each type of pickup tooth or tine has a specific function that is tailored to provide the capability for the pickup header to lift crop material from the ground, feed it to the bale forming chamber and to allow the material to move perpendicular to the windrow into alignment with the bale forming chamber. Important characteristics comprise angle compared to a plane passing through the axis of rotation of the pickup
15 and rigidity or stiffness.

Brief Description of the Drawings

Fig. 1 is a perspective view of the round baler including a pickup attachment of the present invention;
20 **Fig. 2a** is an elevational view of the left side of an empty baler with the left side removed, and showing the pickup of the present invention;
Fig. 2b is an elevational view of the left side of a baler with the left side removed, configured as with a completed bale, and showing the pickup of the present invention;
Fig. 3a is a perspective view of a portion of the pickup with teeth of the present
25 invention;
Fig. 3b is a perspective view of a portion of the pickup without teeth of the present invention;
Fig. 4 is a plan view of the pickup of the present invention, showing the crop flow from a windrow wider than the processing elements to the bale forming chamber;

Fig. 5a is a schematic of the chain drive system to left side of the pickup header of the present invention;

Fig. 5b is a perspective view of the chain drive system to the right side of the pickup header of the present invention; and

5 **Fig. 6** is a schematic illustrating the orientation of the pickup teeth.

Best Mode for Carrying Out the Invention

Referring now to the drawings, like reference numerals designate identical or
10 corresponding parts throughout the several views. The included drawings reflect the current preferred and alternate embodiments. There are many additional embodiments that may utilize the present invention. The drawings are not meant to include all such possible embodiments.

Shown in **Figs. 1, 2a and 2b** is a baler **10** of the type for forming large cylindrical
15 bales of crop material, typically known as a variable chamber large round baler. The baler **10** comprises a tongue **20** adapted to connect to a towing vehicle at a front end and to attach to a tongue beam **30** on the opposite end. The tongue beam **30** typically defines the width of a bale chamber by positioning a left baler side **50**, and a right baler side **52**. The distance between the sides is the effective width of the bale forming
20 chamber.

The baler sides **50, 52** are operably attached at the front to the tongue beam **30** while being attached at the bottom of the opposite end to an axle (not illustrated). Wheels **40**, which define the positions of the side panels **50** and **52** from the ground, support the axle.

25 A pickup header **70** is typically pivotally attached at a pickup header pivot axis **150** to the baler sides **50** and **52** in the vicinity of the wheels **40**. The pickup header includes teeth or tines **72** that are rotated about a pickup header axis **74**. The teeth **72** are effective at engaging the crop material to lift it to the bale forming chamber. The pivotal mounting of the pickup header **70** allows it to move independently of the other

components of the baler, so that it is able to follow the contour of the ground and maintain a consistent ground clearance. The teeth 72 are typically at their lowest point at a line that is parallel to and generally directly below the pickup header axis 74. This is preferably kept close to the wheel 40 so that the relative movement between the pickup 70 and baler sides 50 and 52, as necessitated by variations in topography will be minimized. If the axis of rotation of the wheels 40 could be coincident with the pickup header rotational axis 74, the relative movement would be very limited. As the pickup rotational axis 74 moves further from the axis of rotation of the wheels 40, then the relative movement becomes more critical, to the point that, in some instances, separate wheels are attached near the pickup rotational axis 74, known as gauge wheels.

A pair of tailgate sides, a left tailgate side 60 and a right tailgate side 62, are pivotally attached to the baler sides 50 and 52 near the top, at a tailgate pivot axis 64. The tailgate panels 60, 62 are connected with a variety of components including idler rollers 66 to form a tailgate 68. With the tailgate in the closed position, as shown in Figs. 2a and 2b, the bale forming chamber is defined. The tailgate can be raised, by pivoting around the tailgate pivot axis 64, to a raised position where a formed bale can be ejected from the baler.

The sides of the bale forming chamber are defined, with the tailgate 68 in its closed position, by the baler sides 50 and 52 and the tailgate sides 60 and 62. The circumference of the bale forming chamber is defined by a plurality of belts 92 which are routed around idler rollers 66 in the tailgate, a lower drive roller 80, idler roller 82, upper drive rollers 84 and 86 and belt tightener rollers 88. The bottom of the bale forming chamber is defined by a drum roller 90. Comparing Fig. 2a, in the configuration with an empty bale chamber, with Fig. 2b, in the configuration with a full bale, it can be seen how the bale forming chamber varies in size allowing a bale to grow.

With the baler empty as in Fig. 2a, the bale forming chamber is defined in part by the pickup header 70 and pickup tines or teeth 72. Thus the position of the pickup header 70 relative to the bale forming belts 92 and lower drum 90 has an effect on the

ability of the baler 10 to start a bale, a critical stage of the formation of a bale. As a windrow of crop material enters an empty baler 10 it will fill the void defined by the sides, the lower drum roller 90, the belts 92 and the pickup header 70. At some point the movements of these components, along with the pickup teeth 72, will force that
5 loose forage material to begin to rotate and form a cylindrical bale. The interaction of the components is necessary to initiate this rolling action.

The present invention involves a wide pickup header 70 that replaces a standard pickup header. A standard pickup header is the same width as the bale-forming chamber, the sides of the pickup header are effectively in-line with the baler sides, so
10 the standard pickup header is only able to lift crop material that is positioned within that area. In this standard configuration the material is exclusively moved, by the pickup header 70, in a direction substantially parallel to the windrow.

The wide pickup header 70 of the present invention is notably wider than the bale-forming chamber of the baler and includes the addition of feed components to move a
15 portion of the material in a direction having a component that is perpendicular to the windrow. That portion is the material that initially resides outside the edge of the bale-forming chamber. The aforementioned feed components are pairs of augers 100, 102 on both the left and right sides of the pickup header 70 in the transition zone between the pickup and the bale forming chamber. The pair of augers 100, 102 on the right side of
20 the baler are illustrated in Figs. 3a and 3b. These augers 100, 102 are positioned to move crop material that is outside the width of the bale forming chamber in a direction 112 (see Fig. 4), having a component that is perpendicular to both the direction of travel 110 of the baler, and the direction of travel 114 of the crop material between the baler sides 50, 52, as illustrated in Fig. 4. This allows the pickup header 70 to gather crop
25 materials that are outside the region that a standard pickup header would be effective.

With the arrangement of the present invention the wide pickup header 70 can be positioned forward and aft, relative to the wheels, in substantially the same position as a standard pickup header; due in part to the physical location of and drive arrangement to the feed augers 100, 102.

Figs. 2a and 2b illustrate the position of the augers **100, 102**, just behind the pickup header **70** and in front of the lower drum roller **90**. The augers can be positioned in this area, without forcing the pickup header **70** to be moved, as a result of the physical arrangement of placing one on top of the other. The small diameter of the augers **100,**
5 **102** results in a small horizontal space requirement.

It has been found that the capacity of an auger to move material in this area is affected by the height of the auger, that is, its vertical dimension. With this stacked arrangement the effective vertical dimension of the auger assembly is sufficient to provide acceptable capacity.

10 The performance of the auger pairs **100, 102** is further affected by the drive arrangement. The drive arrangement is illustrated in **Figs. 5a – 5b**. **Fig. 5a** illustrates a main chain drive **120**, located relatively close to the baler's left side **50**, including a first drive sprocket **122** driving a chain that is also looped around a first driven sprocket **500** on the lower drive roller **80** (see **Fig. 2a**) and a second chain drive, driven from a
15 second drive sprocket **510**, which is also mounted on the lower drive roller **80** to a second driven sprocket **124** on the drum roller. The power is transferred through the drum roller to a sprocket **132** on the right side **52** of the baler **10** as shown in **Fig. 5b**. A chain **132z**, on the right side **52**, is driven by the sprocket **132** and drives a sprocket **132a** which is supported by and rotates with a stub shaft **132b**. A stub-shaft sprocket
20 **142** is mounted on and rotates with the stub shaft **132b**. A second chain **142z**, also on the right side, is driven by the stub-shaft sprocket **142**, and drives the auger sprocket **134a1**, which turns the upper auger **102**, as well as the pickup sprocket **144**. A third chain **134z**, on the right side, is driven by a second auger sprocket **134a2**, mounted on the upper auger **102**, and drives auger sprocket **135a**, which drives the lower auger **100**.

25 The power is, again, passed through the baler **10** through the pickup drive shaft to a third chain drive on the left side (see **Fig. 5a**), powered by a drive sprocket **520** on the pickup header, this third chain drive powers the two auger sprockets **134b** and **135b**. The auger drive sprockets **134b** and **135b** comprise a different number of teeth, such that the two augers **100** and **102** on the left side rotate at slightly different speeds, which

results in relative movement between the outer surfaces of the two augers. Likewise, the auger drive sprockets **134a2** and **135a** comprise a different number of teeth, such that the two augers **100** and **102** on the right side rotate at slightly different speeds, which also results in relative movement between the outer surfaces of these two augers.

5 This relative movement prevents material from building up between or wrapping around the augers since the augers scrape against each other in this relationship. This same effect could be accomplished by the use of augers of different diameters turning at the same speed.

Another critical feature for proper performance is the interaction between the pickup teeth **72** and the augers **100, 102**. The pickup header **70** of the present invention utilizes different styles of pickup teeth, as illustrated in **Fig. 3a**. The three styles are illustrated as a laid-back tooth **200** used in the regions in which the teeth pass under the augers **100, 102**; a heavy tooth **202** that is positioned directly beyond the end of the augers toward the inside; and a standard tooth **204** positioned in the middle of the pickup header **70**.

The configuration of the teeth **72** is illustrated in **Figs. 3a** and **6**, with the laid-back teeth **200** tilted in the direction opposite that of rotation **74** when compared to the other teeth **202, 204**, or delayed. An angle between a plane passing through the axis of rotation of the pickup header and a laid back tooth's **200** base is greater than the other teeth **202, 204**. This feature allows the teeth **200** to engage the material on the ground and deliver it to the augers **100, 102** while allowing sufficient clearance for the augers **100, 102** to move the material in a lateral direction **112** towards the bale forming chamber.

Heavy teeth **202** are positioned at the end of the augers **100, 102**, just to the inside of the baler sides **50, 52**. These teeth are substantially more rigid than standard teeth **204**, and their performance tends to increase in a wider variety of crop conditions with increasing stiffness. However, the ability of the heavy teeth **202** to survive excessive deflection that is unavoidable in the event of contact with the ground, or something on the ground, or an object plugging the baler inlet tends to decrease with increasing

stiffness. It has been found that a heavy tooth **202** that requires a minimum force of 45 lb_f applied to its tip in order to cause a deflection of 41 ° provides acceptable performance and acceptable durability. It is recognized that a stiffer tooth in this position would further enhance performance, if a material or tooth design could be
5 identified that provided acceptable durability.

Standard teeth **204** are positioned between the heavy teeth **202**, and require a force of approximately 15 lb_f at their tip to deflect 41 °. Typically the standard teeth **204** are capable of withstanding a greater number of cycles of extreme deflection, than the heavy teeth **202**. The middle of the pickup header **70** is more likely to encounter
10 deviations in the topography not encountered by the wheels, than the sides of the pickup header **70**. Thus, the teeth mounted on the sides will experience fewer events of extreme deflection. This fact at least partially provides the possibility of acceptable tooth longevity while utilizing the heavy teeth **202** in the position illustrated, as it is likely that they will experience fewer cycles of extreme deflection as the result of
15 contact with extreme deviations in the ground conditions.

The heavy teeth **202** are required at the illustrated position to provide extra feeding force to take the material being moved by the augers **100**, **102** and push that material into the bale forming chamber.

Several combinations of these various styles of teeth **200**, **202**, **204** are possible,
20 and may be utilized to provide an optimum configuration for a variety of crop conditions. For instance, in some crops, heavy teeth **202** may not be necessary. In this instance the standard teeth **204** may be installed in the positions where the heavy teeth **202** are illustrated. It is also possible that in some conditions it may be desirable to use heavy teeth **202** wherever the standard teeth **204** are illustrated.

25 The above embodiments are the preferred embodiments, but this invention is not limited thereto. It is, therefore, apparent that many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.